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Determinants of Self-Management Among Diabetic Patients: A Path Analysis

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Abstract

Diabetes self-management (DSM) is a complex behavior and various factors influence it. Despite continual recommendations to DSM, implementation of this behavior still remains a major health problem for diabetic patients. Identifying effective factors in DSM is useful to promote health in diabetic patients. The purpose of this study was to test the effects of individual and environmental factors on DSM. Path analysis was used to examine both one-way direct and indirect effects of 7 constructs and 3 demographic factors on DSM in this population (N = 396). Data were collected from a convenience sample of 104 (26.3%) males and 292 (73.7%) females with a median age 53 years. The final model provided a good fit to the data explaining 25% of the variance in DSM. Illness perception and provider–patient communication were the most effective factors in DSM. Knowledge and self-efficacy affected DSM indirectly via illness perception. The results of this study showed that effective DSM interventions should be designed to change illness perception and patient–provider communication, especially in patients with low duration of diabetes and low level of education.

Keywords

diabetes self-management, determinant factors, path analysis

Introduction

Diabetes mellitus is one of the pandemic metabolic disorders that is associated with long-term complications.[1] According to the recent estimates of the World Health Organization, by the year 2030 there will be 366 million diabetic patients in the world.[2] Therefore, health care expenditure for diabetes will be a heavy financial burden in the future.[3] Despite developments in medicine and pharmacology, diabetes control remains difficult.[4] This incoherence reflects the central role that individuals play in determining their diabetes status. Self-management in diabetes is necessary to keep the illness under control, because as much as 95% of the self-care is usually provided by the ill persons.[5] Self-managing the disease includes following a prescribed medication

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regimen and strict calorie-controlled diet, doing regular exercise, undertaking blood glucose checks, and caring for feet.[6]

Diabetes self-management (DSM) is a complex behavior and various factors influence it. Therefore, an important challenge to health professionals is to identify the factors that differentiate between those patients who do and those who do not successfully adjust to their condition. Identifying these factors may help in developing effective interventions to promote short- and long-term health in diabetic patients.

Determinants of diabetic self- management can be individual (diabetes knowledge, diabetes-specific self-efficacy, illness perception, personality, and several demographic factors such as age, duration of diabetes, and educational level) and environmental (provider–patient communication and social support such as policy/organizational and family/friend) factors.

Diabetes Knowledge and DSM

Several investigators have examined diabetes knowledge as a factor affecting DSM. Several studies have found that patients who participated in a diabetes education intervention had a significantly greater improvement in health outcomes.[7] Conversely, several investigators found no association between knowledge and adherence.[8] Despite inconsistent findings, knowledge is considered the basis of DSM performance because patients must know about their condition to manage it.[8]

Self-Efficacy and DSM

Several studies have demonstrated that perceived self-efficacy could lead to self-management behaviors among diabetic patients, with higher levels of diabetes self-efficacy promoting self-management.[9] Also systematic review investigations about self-efficacy in patients with diabetes indicate that self-efficacy positively influences health behaviors.[10] In addition, self-efficacy appears to mediate the relation between diabetes knowledge and DSM.[11]

Illness Perception and DSM

Leventhal and colleagues developed the self-regulatory model to describe the process by which individuals respond to a perceived health threat. The model proposes that situational stimuli (such as symptoms) generate both cognitive and emotional representations of the illness.[12] These representations are processed through 3 stages. The individual first forms the representation of the illness or health threat; next, they adopt behaviors to cope with this; and last, they appraise the efficacy of these behaviors.[13] Changing patients' illness perceptions has been shown to improve recovery following myocardial infarction,[14] and other self-regulatory interventions in diabetes have also improved patient outcomes.[15] Previous research has found higher perceived control beliefs to be related to better self-reported adherence to diet, medication, and exercise, as well as better metabolic control through self-efficacy.[15]

Personality and DSM

Research examining the main effects of personality on medical regimen adherence has yielded inconsistent results. The 5 basic dimensions have been labeled variously by different personality researchers. The most important individual differences in adults' personality characteristics can be organized in terms of 5 broad trait domains: Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness.[16] Conscientious individuals have been described as self-controlled,

organized, purposeful, strong-willed, and determined.[17] Conscientiousness is found to be the most consistently significant predictor of many health behavior dimensions and patient adherence. Such a pattern may be the result of defective coping patterns associated with high levels of anxious arousal and has implications for therapeutic interventions targeted at modifying health beliefs among chronically ill patients following prescribed medical regimens.[17]

Social Support and DSM

Previous researches suggest that social support is positively associated with chronic illness self-management, particularly for DSM.[8] Research evidence confirmed the importance of multiple types and multiple levels of support for healthy lifestyle behaviors and chronic illness self-management including family and friends, the neighborhood, community, media, and health policies.[18,19] Family support appears to benefit DSM directly[20] and indirectly through improvement in self-efficacy.[8]

Provider–Patient Communication and DSM

Researchers have suggested that provider communication was a statistically significant predictor of DSM, as this communication increased the probability of performing DSM behaviors.[21] One study reported that improving both general provider–patient communication and diabetes-specific communication showed 4-fold improvement for foot care and 9-fold improvement for diet self-care behavior.[22]

In spite of continual recommendations to DSM, implementation of this behavior still remains a major health problem for diabetic patients. Therefore, identifying effective factors in DSM is useful to promote health in diabetic patients. The purpose of this study was to test a hypothesized model describing the effects of individual and environmental factors on DSM.

Method

Participants

In all, 415 patients suffering from diabetes were recruited from the Outpatient Department of the Endocrinology Unit through a convenience sampling procedure. The sample size was determined based on the ratio of the number of participants to the number of model parameters. Kline indicated that 20:1 is a desirable ratio of participants to parameters, but 10:1 is more realistic.[23] The hypothesized model in this study incorporates 40 parameters. A count of the parameters is as follows: 18 path coefficients, 12 correlation coefficients among the independent variables, 3 equation error variances, and 7 independent variable variances (30 coefficients and 10 variances). Thus, based on a 10:1 ratio, a sample size of 400 was selected for the study. To allow for potential missing data (almost 4% attrition rate), the initial sample was set at 415. The inclusion criteria were older than 18 years, not gestational diabetes, having diabetes for 1 or more years, lacking mental and/or physical disabilities, and having the ability to read and write. The aim of the study was verbally explained to the potential participants who met the inclusion criteria. The participants were told that all information would be kept secret and anonymous. They were also requested to choose the answer that best described their beliefs and opinions. The participants completed questionnaires right away on the site. From the total of 415 patients, 19 participants submitted imperfect data in the questionnaire, so they were excluded from the study. The final sample included in the path analysis was 396, yielding a 95.4% response rate.

Instruments and Measures

Six questionnaires were used as the data collection instruments. All the instruments were first translated by the primary investigator and a bilingual person then validated them by the back-translation technique. The translated instruments were reviewed by a group of Iranian health education experts. In this study, no items were changed. Prior to data collection, the questionnaires were tested for reliability in a sample of 50 patients. All the questionnaires were reliable and the ranges of Cronbach's α coefficients were .69 (diabetes knowledge) to .92 (diabetes self-management).

Diabetes self-management. This measure was defined as behaviors performed by individuals to manage their condition. Lin et al designed the Diabetes Self-Management Scale (DSMS) for Chinese patients. The 35 items of this questionnaire loaded in 5 factors model named self-integration, self-regulation, interaction with health professionals and significant others, self-monitoring of blood glucose, and adherence to recommendation regimen. The final DSMS is a 4-point Likert-type scale, from 1 = *not relevant* to 4 = *very relevant*.[24]

Diabetes knowledge. This measure was defined as patient understanding of information about diabetes and its management. In this study, the Brief Diabetes Knowledge Test (BDKT) was used for evaluating diabetes knowledge. The BDKT was designed to measure patients' knowledge in 2 components: a 14-item general test and a 9-item insulin-use subscale. This scale is an effective, efficient, and inexpensive way to obtain a general assessment of a patient's knowledge about diabetes and its care. Cronbach's αs for the general test and insulin use were .71 and .75, respectively.[25] Cronbach's αs in the Iranian patients for the general test and insulin use were .69 was .67, respectively. Participants received a score of 1 for a correct answer or 0 for an incorrect or unknown answer. The total score could range from 0 to 14 for patients who did not receive insulin and from 0 to 23 for patients who received insulin (for assimilating, these patient scores were converted to 14), with a higher score indicating a higher level of diabetes knowledge.

Illness perception. For evaluation of illness perception, we used the Brief Illness Perception Questionnaire (IPQ).[13] This questionnaire is a widely used multifactorial pencil-and-paper questionnaire based on Leventhal's self-regulatory model, which assesses the 5 cognitive illness representations. The Brief IPQ has 8 items wherein all the items are rated using a 0 to 10 response scale. Five of the items assess cognitive illness representations: consequences (item 1), timeline (item 2), personal control (item 3), treatment control (item 4), and identity (item 5). Two of the items assess emotional representations: concern (item 6) and emotions (item 8). One item assesses illness comprehensibility (item 7).[13] Several items (items 3, 4, and 7) were reverse scored. Higher scores of this scale indicate a positive perception of diabetes. The questionnaires were reliable and the ranges of test–retest correlations in a 6-week period were .48 (personal control) to 0.75 (identity). These correlations demonstrate that the items have good test–retest reliability over time.[13]

Diabetes self-efficacy. Self-efficacy refers to people's judgments on their own possibilities in relation to situational behavior. In 1999, Bijl et al designed an appropriate self-efficacy scale for measuring self-management behavior in diabetic patients. The original version of this 20-item scale assesses the extent to which patients are confident they can manage their blood sugar, diet, and level of exercise.[26] This scale has since been adapted for use in several countries, including Australia[6] and China.[1]

In this scale, the items were scored on a 5-point Likert-type scale, with higher scores indicating higher self-efficacy in performing DSM activities. The Chinese version of the self-efficacy measure had a Cronbach's α of .87, and items loaded on 4 factors that explained 68.3% of the variance.[1] Psychometric evaluation of this scale among Iranian patients has been described in detail elsewhere.[27]

Personality. We used the Big Five Inventory to assess conscientiousness personality. The Big Five Inventory is a 44-item questionnaire that assesses 5 broad trait domains: Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness.[16] Seven items (items 8, 13, 18, 23, 28, 38, and 43) assess conscientiousness personality, and several items (items 8, 18, 23, and 43) were reverse scored. Cronbach's α for conscientiousness personality was .71.[16] In this study, Cronbach's α for this domain of personality was .67.

Social support. Social support was defined as the perception of support from different resources and was measured with the Chronic Illness Resources Survey (CIRS).[28] The CIRS is composed of 8 subscales reflecting informational, emotional, and tangible support received from health care team, family and friends, personal actions, neighborhood, community, media policy, community organizations, and workplace. The family/friends/neighborhood and policy/organizational support subscales were adapted for this study. Glasgow et al reported Cronbach's αs of .66 and .65 for the family/friends and policy/organizational support subscales of the CIRS, respectively. The family/friend and policy/organizational subscale consisted of 7 items and 6 items, respectively, measuring the extent to which individuals perceived that they received emotional support, tangible aids, and appraisal in the prior 3 months. The items were scored on a 5-point Likert-type scale, with higher scores indicating greater perceived support.[28]

Provider–patient communication. This construct was defined as the patient's perception of support from the physician and measured by the CIRS, which had a Cronbach's α of .86. This subscale contained 3 items measuring the physician's general clarity, explanations of diabetes care, and responsiveness to personal concerns. Responses were on a 5-point Likert-type scale, with higher scores indicating better communication between patients and their physicians.[28]

Data Analysis

The collected data were analyzed by path analysis using LISREL, version 8.80. Path analysis is used as a method for studying the direct and indirect effects of variables and for estimating the values of the coefficients in the underpinning linear model. Mardia's coefficient for multivariate skewness was 20.88, and kurtosis was estimated to be 11.29. These values were significant ($P < .001$); therefore, some of the variables were nonnormal. Therefore, we used the robust maximum likelihood estimation procedure. A correlation matrix and an asymptotic covariance matrix were applied to model estimation. Chi-square test, adjusted goodness-of-fit index (AGFI), and root-mean-square error of approximation (RMSEA) were used as model fit criteria. The model was considered fit if the AGFI value was greater than .8 and if the RMSEA value was less than .08. With regard to comparative fit index, Bentler–Bonett nonnormed fit index (NNFI) was selected. Values of .90 or greater for NNFI are recommended as acceptable values for this measure. *T* value was used for elimination of the parameters in the path analysis, and a modification index was used for inclusion of additional parameters.

Results

A total of 396 participants were included in the study, with an age range of 15 to 91 years (median = 53, mean = 51.78, standard deviation = 12.7). Median disease duration was 6 years (range = 1-40 years). Most of the participants 76% (n = 301) had education of the primary/secondary level, 16.9% (n = 67) had graduated from high school, and 7.1% (n = 28) had obtained a college degree. In this study, most of the patients (69.2%; n = 274) were housekeepers. Of these, 26.3% (104) were males and 73.7% (292) females.

Of all, 21.7% (n = 86) used insulin, 69.9% (n= 277) were treated with oral drugs, 3.8% (n = 15) had a diabetic diet, and 4.5% (n = 18) used mixed treatment. Most of the patients in this study

Table 1. Means, Standard Deviations, and Minimum and Maximum of the Constructs and DSM (N = 396).

Variable	Personality	Illness Perception	Communication	Family Support	Community Support	Self-Efficacy	Knowledge	DSM
Mean	26.78	42.39	11.26	18.07	16.53	47.33	12.74	95.5
Standard deviation	4.87	10.47	2.23	5.43	3.62	10.68	2.54	13.9
Min-max	10-35	12-76	3-15	7-28	7-28	21-88	5-20	38-137
Range scale	7-35	0-80	3-15	7-35	6-30	20-100	0-23	35-140

Abbreviation: DSM, diabetes self-management.

Table 2. Correlation Coefficients Among the Constructs and Diabetes Self-Management.

	Personality	Illness Perception	Communication	Family Support	Community Support	Self-Efficacy	Knowledge	DSM
Personality	1							
Illness perception	−0.237**	1						
Communication	0.172**	0.140**	1					
Family support	0.225**	0.360**	0.178**	1				
Community Support	0.249**	0.271**	0.221**	0.482**	1			
Self-efficacy	−0.377**	0.411**	−0.268**	−0.568**	−0.553**	1		
Knowledge	0.230**	−0.061	0.172**	0.272**	0.22**	−0.192**	1	
DSM	0.417**	−0.324**	0.353**	0.538**	0.459**	−0.573**	0.269**	1

Abbreviation: DSM, diabetes self-management.
**$P < .01$ (2-tailed).

had a family history of diabetes (63.7%). Average responses for the 7 construct and DSM are summarized in Table 1. The results (according to the mean values obtained) demonstrated that the participants in this study believed that they had low levels of self-efficacy of DSM. Also, the patients perceived medium levels of illness perception, family/friend support, policy/organizational support, and knowledge related to DSM. They also had high levels of provider–patient communication.

Pearson's correlation coefficients between constructs and DSM are given in Table 2. A positive association was found between DSM and personality, provider–patient communication, family/friend support, policy/organizational support, and knowledge about self-management. A negative association was found between DSM and self-efficacy and illness perception. Therefore, the patients who had negative perception of diabetes performed fewer DSM.

Structural Model

The original hypothesized model did not result in a good fit to the data ($\chi^2 = 50.04$, $df = 8$, $P < .001$, RMSEA = .12 [.09-.15], NFI = .97, GFI = .98, AGFI = .82). Examination of the coefficients of the paths in the hypothesized model revealed that some coefficients were significant and some were not. After considering the results of the original model and the related theoretical issues, the model was modified by dropping several paths with nonsignificant coefficients one by one between demographic factors and constructs. The fit indices indicated improvement of

the modified model over the original model ($\chi^2 = 61.14$, $df = 25$, $P < .001$, RMSEA = .061 [.04-.08], NFI = .96, GFI = .97, AGFI = .93). The coefficients between the variables were improved, and all the paths in the modified model were significant. Although the χ^2 statistics indicated that the null hypothesis for this study was rejected, χ^2 statistics are known to be sensitive to a large sample size. Other fit indices such as GFI and AGFI, which had not been affected by sample size, indicated a good fit of the model (values >.9).

The results indicated that duration of diabetes affected DSM directly and indirectly through self-efficacy and illness perception. Among the demographic factors, duration of diabetes had the most effect in DSM, with a factor loading of .243. Also, education level had positive direct and indirect effects on DSM (factor loading = .235).

The results indicated that all constructs except knowledge about diabetes self-management positively influenced DSM. Self-efficacy and knowledge had indirect effects in DSM.

In this study, the most effective factors in DSM were illness perception and provider–patient communication, with the highest factor loadings of .18 and .175, respectively. Illness perception had a direct effect in DSM. Provider–patient communication had a positive direct and indirect effect through knowledge, self-efficacy, and illness perception in DSM. Direct and indirect influences of the demographic factors and constructs on DSM are shown in Tables 3. This model accounted for only 25% of the variance in DSM among Iranian diabetic patients.

Discussion

The results of this study support direct and indirect effects of individual and environmental factors in DSM. In the model fit, illness perception was a significant factor influencing DSM, which is in accordance to findings of other studies.[8,11] A recent approach to understanding adaptation to illness indicates that the manner in which people adapt to chronic health problems is influenced by their appraisal and perceptions of their illness. Illness perceptions have significant implications for adaptation to illness.[29] In the current study, positive perception of illness is one resource for DSM. Therefore, health interventions based on modifying perceptions of illness may prove useful in facilitating patient self-management.

In this study, the significant direct relationship between provider–patient communication and DSM emphasizes the importance of the link between the physician and patient, which is similar to the findings in previous researches.[21] Also, provider–patient communication can influence DSM through changing knowledge, self-efficacy, and illness perception. A positive communication between physician and patient may improve patient's understanding and recall of information about disease.[8] The interaction between provider and patient could reinforce patient's self-efficacy. Also, better provider–patient communication may help build trusting relationships between the patient and the physician and promote the patient's DSM.[8] Therefore, the communication between the provider and the patient may play a more important role in building knowledge, belief about treatment, and confidence in the management of their diabetes.

In this study, support from family/friend and policy/organizational was found to affect DSM directly and indirectly through knowledge, self-efficacy, and illness perception, in accordance with findings of other studies.[8] The social support (family/friend and policy/organizational) modifies illness perception. Consistent with previous findings, supportive environments may encourage the adoption of patients' representations of their disease, including disease-related belief.[8] Also, social support is a source of self-efficacy, and the social environment might facilitate or limit personal self-efficacy.[30]

In this study, knowledge did not lead to behavior change directly. Instead, knowledge affected DSM indirectly through illness perception and self-efficacy, similar to the findings in another study.[8] Preparation of adequate knowledge is important to improve DSM, but individual's

Table 3. Direct and Indirect Influences of Demographic Factors and Constructs on DSM.

		Causal Effect		
Predictor Variables	Through	Direct	Indirect	Total
Age	—	−0.1	—	
	PPC	—	0.0165	
	PPC, K, IP	—	0.0022	
	PPC, K, SE, IP	—	0.0005	
	FFS	—	−0.0096	
	FFS, K, IP	—	−0.0013	
	FFS, K, SE, IP	—	−0.0002	
	IP	—	−0.0288	
	SE, IP	—	−0.0058	
	K, IP	—	−0.0116	
	K, SE, IP	—	−0.0027	
	Total	−0.1	−0.0408	−0.1408
Duration diabetes	—	0.24	—	
	SE, IP	—	0.0029	
	Total	0.24	0.0029	0.2429
Education	—	0.18	—	
	PPC	—	0.054	
	PPC, K, IP	—	0.0074	
	PPC, K, SE, IP	—	0.0017	
	SE, IP	—	0.0065	
	POS	—	−0.031	
	POS, IP	—	0.0089	
	POS, K, IP	—	0.0064	
	POS, K, SE, IP	—	0.0015	
	Total	0.18	0.0554	0.2354
Personality	SE, IP	—	−0.0043	
	Total	0.000	−0.0043	−0.0043
Provider—patient communication	—	0.15	—	
	K, IP	—	0.0205	
	K, SE, IP	—	0.0047	
	Total	0.15	0.0252	0.1752
Family/friend support	—	0.08	—	
	K, IP	—	0.0109	
	K, SE, IP	—	0.0025	
	Total	0.08	0.0134	0.0934
Illness perception	—	0.18	—	
	Total	0.18	0.000	0.18
Self-efficacy	IP	—	0.036	
	Total	0.0000	0.036	0.036
Knowledge	IP	—	−0.0684	
	SE, IP	—	−0.0158	
	Total	0.000	−0.0842	−0.0842
Policy/organizational support	—	0.1	—	
	IP	—	−0.0288	
	K, IP	—	−0.0205	
	K,SE, IP	—	−0.0047	
	Total	0.1	−0.054	0.0415

Abbreviations: DSM, diabetes self-management; PPC, provider–patient communication; K, knowledge; SE, self-efficacy; IP, illness perception; FFS, family/friend support; POS, policy/organizational support.

perception about disease is also involved. Therefore, knowledge is necessary but not sufficient for behavior change in DSM, and an intervention targeted to address the mediator role of illness perception and self-efficacy, rather than knowledge alone, would be expected to improve DSM performance.

A remarkable finding of this study was that the direct path from self-efficacy to DSM in the other study was nonsignificant.[5,8,11] Self-efficacy affected DSM indirectly through illness perception. Bandura[30] proposes 2 types of expectancies that influence behavior: outcome and efficacy. Outcome expectancy refers to the belief that certain behavior will lead to certain outcomes (illness perception). Efficacy expectancy is the belief that one can successfully perform the behavior required to produce the outcomes (self-efficacy). Also, according to Bandura,[30] strength of individuals' beliefs about their ability to produce a specific outcome determines whether or not they attempt to deal with a difficult situation. In addition, self-efficacy expectations vary on several dimensions such as magnitude, generality, and strength. Magnitude refers to the level of difficulty of the task. Generality refers to the extent that a domain of behavior can be generalized to other situations. Strength refers to the confidence individuals have in the accomplishment of a specific task.[30] Several areas of DSM such as diet, adjusting insulin, and managing diabetes outside home are difficult (high magnitude) and specific (low generality). These areas were also identified as those resulting in low perceived self-efficacy. Given perceiving diabetes as chronic, reporting a high number of symptoms and high perceived illness severity, and low perceived illness control the patients had low self-efficacy. Therefore, self-efficacy only through illness perception affected DSM.

Contrary to prediction, conscientiousness personality did not lead to DSM directly but affected DSM indirectly through illness perception and self-efficacy. Empirical support for the use of conscientiousness to predict DSM remains limited. In hemodialysis patients, conscientiousness failed to explain a significant portion of the variance in adherence to fluid restrictions. It is possible that the combination of high conscientiousness and negative illness perception was associated with poorer DSM. Such a pattern may be the result of defective coping patterns associated with high levels of anxious arousal.[17]

As for limitations of this study, conclusions from self-report data also demand caution. Overestimation might adversely affect self-reports of DSM and other constructs. Since this study was based on a convenience sample because of inaccessibility to patient by probability sampling, the findings of this study may not be generalized to all Iranian diabetic patients.

The results of this study help recognize the ways in which individual and environmental factors affect DSM. Based on the findings of this study, instead of providing educational information alone, effective DSM interventions should be designed to change illness perception and patient–provider communication especially in patient with low duration of diabetes and low level of education.

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